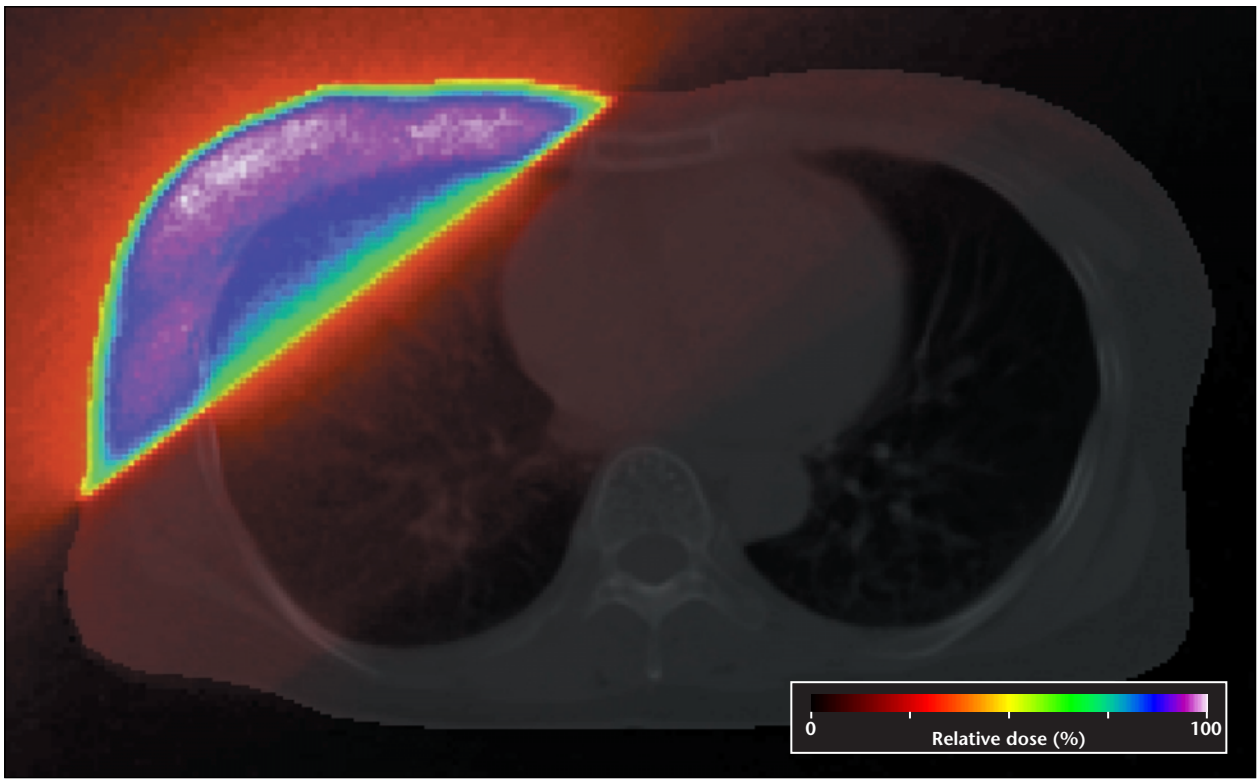
PEREGRINE: BREAST



Two-beam tangential-field breast treatment; 6 MV photon beams.

Introduction

PEREGRINE is a 3D Monte Carlo dose calculation system designed specifically for radiation therapy. The main advantages of Monte Carlo dose calculations are their robustness for a wide range of beam modifiers and beam geometries and their inherent accuracy in the presence of three-dimensional surface irregularities, missing tissue, and tissue heterogeneities.

Current dose calculation methods approximate dose distributions in the patient based on dose distributions in water. PEREGRINE determines the dose in the patient by directly simulating particle transport through both the beam delivery system and patient.

Accuracy for Breast

External beam radiation therapy of breast cancer requires accurate dose calculations for a variety of field and patient characteristics. The measurement comparisons (on the reverse side) highlight PEREGRINE's accuracy for three dose calculation conditions present in breast cancer treatment plans: dose profiles for a large field, an irregular (sloped) surface, and a lung heterogeneity. All comparisons are made for 6-MV photon beams.

All measurements were made at the University of California at San Francisco on a Varian 2100C 6-MV photon beam using a Scanditronix photon diode (0.45 mm thick, 2.5 mm diameter, p-type silicon detector) or a Wellhofer IC-10 air-equivalent ion chamber (6 mm outer diameter, 0.4 mm wall thickness, 3.3 mm active length). All water phantom measurements were made at a source-to-surface distance of 90 cm. The lung heterogeneity consisted of a 2-cm half-slab (covering half the beam) of 0.3 g/cm3 density lung-equivalent material manufactured by Gammex RMI, located at a depth of 3 cm.

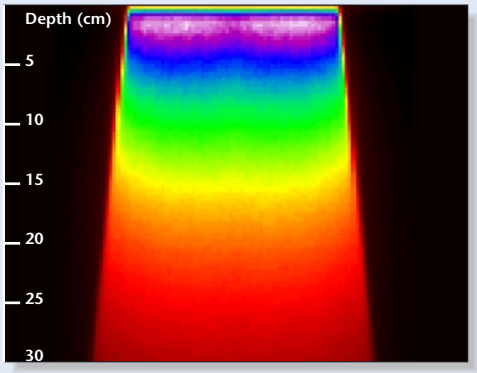
All measurements and calculations are reported in absolute dose per monitor unit. Ion chamber measurements have been corrected for effective chamber position, but not for position-dependent variation in the electron energy spectrum in the ion chamber cavity, which could affect the accuracy of measurements in the buildup region ($D < D_{max}$) and outside the beam penumbra.

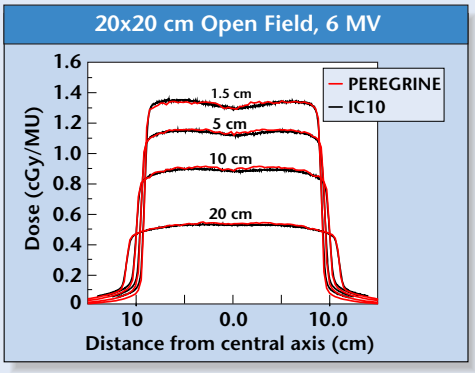
Results demonstrate PEREGRINE's accuracy for predicting absolute dose per monitor unit, dose profiles for large fields, and the effects of irregular surfaces and tissue heterogeneities on the distribution of dose.

PEREGRINE

Large Fields

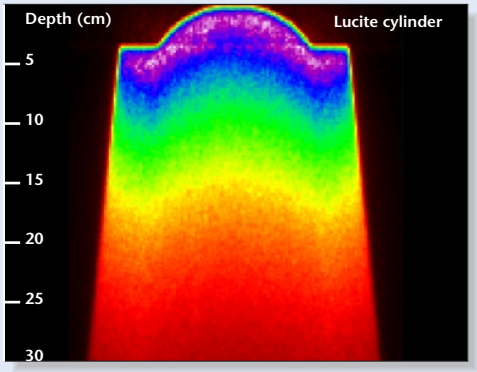
PEREGRINE's full-physics source model accurately predicts dose throughout the phantom

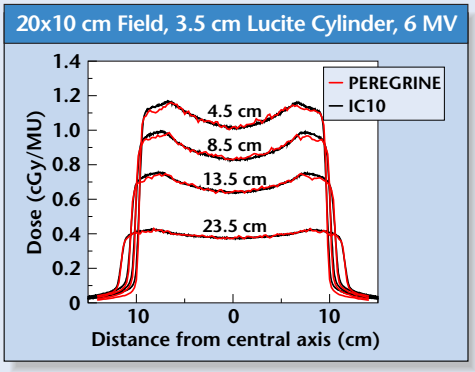




Irregular Surfaces

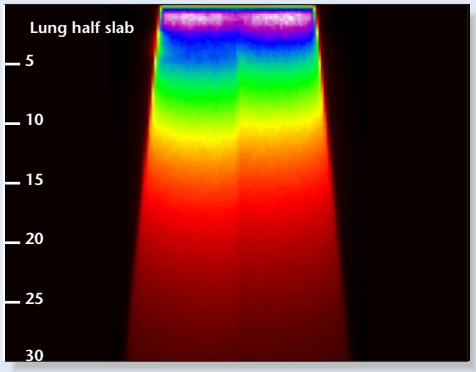
PEREGRINE accurately models the effects of irregular and sloped surfaces

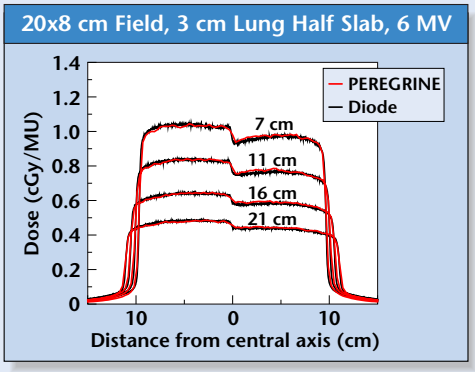




Lung Heterogeneity

PEREGRINE accurately predicts the effects of lung tissue on dose





PEREGRINE

Lawrence Livermore National Laboratory

7000 East Ave., L-174 Phone: 925 422 7473
Livermore CA 94550 Fax: 925 423 1447

E-mail: peregrine@llnl.gov
Website: http://www.llnl.gov/peregrine/

PEREGRINE is a work in progress. The PEREGRINE technology has been licensed to NOMOS Corporation for distribution.

Work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.